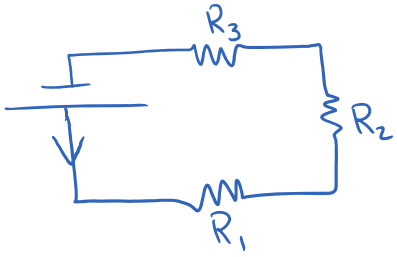
6.3 Kirchhoff's Laws

January 8, 2018 12:38 PM

e^- → energy - voltage
→ motion - current

Series - the current flows through everything in circuit (no choice)
- in series with the battery



$V_S = V_1 + V_2 + V_3 + \cdots = V_{AB}$

V_S: total series voltage; V_{AB}: Terminal voltage

(e^-'s drop energy at each resistor in series)

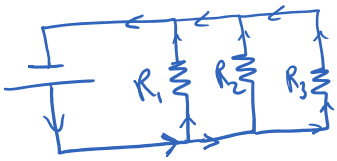
$I_S = I_1 = I_2 = I_3 = \cdots$

(all e^-'s go through everything in series)

$R_S = R_1 + R_2 + R_3 + \cdots$

R_S: equivalent resistance in series

Parallel - e^-'s have a choice of paths to follow
- parallel w.r.t. the battery



$V_p = V_1 = V_2 = V_3 = \cdots = V_{AB}$

V_p: parallel; V_{AB}: terminal voltage

(e^-'s divide btwn paths and drop the same energy at each resistor)

$I_p = I_1 + I_2 + I_3 + \cdots$

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$

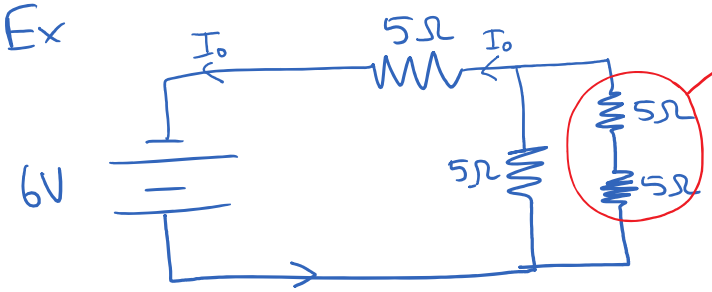
(to solve $\frac{1}{R_p} = \frac{x}{y}$, $R_p = \frac{y}{x}$)

Combined series and parallel
- reduce it part by part.

Ex I_0 5Ω I_0

① Series $5\Omega + 5\Omega = 10\Omega$

Ex

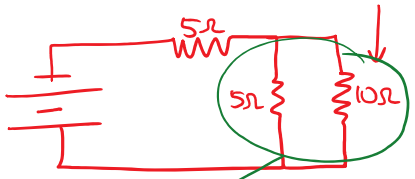


$I_o = ?$
= total current out of battery

$I_o = \frac{V_{AB}}{R_T} = \frac{6V}{?}$

① Series

$5\Omega + 5\Omega = 10\Omega$

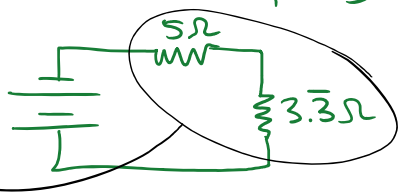


② Parallel

$\frac{1}{R_p} = \frac{1}{5} + \frac{1}{10} = \frac{2}{10} + \frac{1}{10} = \frac{3}{10}$

$\frac{1}{R_p} = \frac{3}{10}$

$\rightarrow R_p = \frac{10}{3} = 3.\bar{3}\Omega$



③ Series

$5\Omega + 3.\bar{3}\Omega$

$= 8.\bar{3}\Omega = R_T$

④ $I_o = \frac{6V}{8.\bar{3}\Omega} = 0.72A$

In Summary

Kirchhoff's Current Rule - the sum of all currents entering a junction equals the sum leaving.

Kirchhoff's Voltage Rule - the sum of all voltage drops of one e^- around the circuit equals the terminal voltage put into the circuit.

Practice
- pg 245 #1-2
- pg 246 #1-4
- Worksheet #1-7